Patterns of Household Food Expenditures:

A Cluster Analysis

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Abstract

In this study we use the Diary Survey component of the 2001 and 2002 Consumer Expenditure Survey to investigate patterns of household food expenditures. We identify eight constellations of food expenditures that are more and less likely to be associated with healthy eating habits. These clusters include: Balanced, Full-service-dominated, Fast-food-dominated, Meat-eater, Miscellaneous-foods-dominated, Alcohol-dominated, Beverage-dominated, and Food-at-work-dominated. Only 29% of the households are in the Balanced cluster, which is likely to represent the most healthy eating pattern. A full 40% of the households are in one of the three food-away-from-home clusters. Exploratory multivariate analysis shows that younger households are more likely to be in the Fast-food-dominated cluster, single male-headed households more likely to be in the Alcohol-dominated cluster, and minorities more likely to be in the Meat-eater cluster. Adult work hours and income-to-needs ratios are found to be positively associated with membership in the Full-service and Fast-food clusters.

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The 2001 report "The Surgeon General's Call To Action To Prevent and Decrease Overweight and Obesity" identified overweight and obesity as major public health problems costing U.S. society as much as $117 billion a year and posing as large a threat of morbidity as poverty, smoking, or problem drinking (U.S. Department of Health and Human Services 2001). The percentage of the U.S. population that is obese or overweight has been rising in recent years. Data from National Health and Nutrition Examination Survey (NHANES) show that in 1999-2002, 65% of U.S. adults age 20-74 were overweight or obese. This is a substantial increase from the 56% estimated from the 1988-1994 NHANES and the 47% estimated from the 1976-1980 NHANES (Flegal, Carroll et al. 2002; Hedley, Ogden et al. 2004; National Center for Health Statistics 2005).

The situation for children is just as grim . The percentage of children who are overweight (defined as BMI-for-age at or above the 95th percentile of the CDC Growth Charts) has also been increasing. Among children and teens ages 6-19, 16% (over 9 million) are overweight according to the 1999-2000 NHANES data, tripling the percentage from 1980 (Ogden, Flegal et al. 2002; Hedley, Ogden et al. 2004; National Center for Health Statistics 2005).

An energy balance approach to the causes of overweight and obesity suggests that obesity and overweight are caused by either eating too much, or exercising too little, or both. The focus of this research is to study the input component of this balance by investigating household food expenditure patterns. The literature linking food consumption and obesity can be classified into three categories: (1) type of food intake, (2) amount of energy intake, and (3) location of food intake. Published research has found associations between obesity and a high level of consumption of artificial sweetner,

meat and meat products, high-fructose corn syrup, and soda. Obesity has also been found to be correlated with a low level of consumption of milk, dairy products, bread, and other cereal-based goods (Stellman and Garfinkel 1988; Heseker, Hartmann et al. 1995; Bray, Nielsen et al. 2004). The amount of energy intake is found to be positively associated with BMI in controlled laboratory studies, although this association is found to be weak or non-existent in population-based studies, possibly due to measurement issues (Weber, Klesges et al. 1988; Heseker, Hartmann et al. 1995). It has been consistently found that the frequency of eating food away from home is positively associated with obesity and body fatness (McCrory, Fuss et al. 1999; Bowman and Vinyard 2004; Pereira, Kartashov et al. 2005). Eating out more frequently is associated with a diet high in energy density such as fat, and low in essential micronutrients and fiber such as vegetables (McCrory, Fuss et al. 1999; Bowman and Vinyard 2004; Satia, Galanko et al. 2004; Pereira, Kartashov et al. 2005). Food away from home, especially fast food consumption, is linked to more intake of energy (McCrory, Fuss et al. 1999; Burns, Jackson et al. 2002; Bowman and Vinyard 2004; Pereira, Kartashov et al. 2005).

Research on patterns of food expenditures or food consumption has shown a trend of increasing consumption of refined carbohydrates and fats from the mid 1980s to the late 1990s ((Putnam, Allshouse et al. 2002). Using U.S. Department of Agriculture Economic Research Services' loss-adjusted annual per capita food supply series, researchers also found that the average daily calorie consumption in the U.S. in 2000 was 12 percent, or roughly 300 calories, above the 1985 level. There is also a trend of more food away from home, both in terms of the number of people eating out and the frequency of eating out ((Kant and Graubard 2004), and in terms of percentage of total

calories coming from food away from home (Guthrie, Lin et al. 2002). These trends of types of food intake, amount of calorie intake, and location of food intake are all consistent with the observed increases in rates of obesity.

Analyses of food intake patterns can provide some insights regarding the causes of obesity. There are several approaches of studying household food intake. At one end of the spectrum one can study specific foods in great detail in order to see exactly what people are eating. Such an approach, however, is likely to lead to hundreds, if not thousand of food categories. The overall picture can get lost in such detailed analyses. On the other end of the spectrum, one can argue that total caloric intake is the only thing that matters. Yet, there is some evidence showing that holding calorie intake constant, different types of food may have different impact on weight gain, possibly due to differences in glycemic index (Atkins 2002; Ludwig and Eckel 2002; Agatston 2003). We choose to use a middle-ground approach by starting from detailed food categories, and using cluster analysis to identify major types of household food expenditure patterns. We further study this issue by investigating what demographic factors may be associated with the probability of households having a particular food expenditure pattern.

Ultimately, it is the overall pattern of food intake, rather than the intake of one or two particular food items, that will determine energy intake and thus affect BMI. In most cases, the first step of behavior change is at the point of purchase, followed by the point of consumption. Identifying expenditure patterns can thus help us to understand which socio-demographic groups are more likely to have food expenditure patterns that put them at a higher risk of obesity. In turn, such an analysis may be useful for consumers, educators, and policy makers in their efforts to fight the obesity epidemic.

Data

The Diary Survey component of the Consumer Expenditure Surveys (CEX-DS) is utilized to study household food expenditure patterns. The ongoing CEX-DS is conducted by the U.S. Bureau of Labor Statistics (BLS) and provides a continuous flow of information on the buying habits of American consumers (U.S. Dept. of Labor and Bureau of Labor Statistics 2002). The Diary Survey is completed by the sample consumer units for two consecutive one-week periods. It contains consumer information on small, frequently-purchased items such as food, beverages, food consumed away from home, gasoline, housekeeping supplies, nonprescription drugs and medical supplies, and personal care products and services. Participants are asked to maintain expense records, or diaries, of all purchases made each day for two consecutive one-week periods. In addition, information on consumer unit characteristics, consumer unit income, and characteristics and earnings of the reference person and his or her spouse is collected. The CEX-DS sample is a national probability sample of households designed to represent the total noninstitutional civilian population of the United States. For this study, the 2001 and 2002 CEX-DS are used (U.S. Dept. of Labor and Bureau of Labor Statistics 2001; U.S. Dept. of Labor and Bureau of Labor Statistics 2002). After eliminating households who are incomplete income reporters, the sample size for this study is 10,967 households with diary data collected in either 2001 or 2002.

Method and Measurement for Cluster Analysis

Cluster analysis is a multivariate technique with which households can be naturally grouped based on similarities in their budget allocation patterns through maximizing within group similarities and between group differences ((Johnson and Wichern 1998). The identification of clusters is empirically based instead of theory-guided. For this study, the similarity measurement used is the Euclidian distance, and the centroid method of measuring similarity is employed since this method is more robust to outliers than most other hierarchical methods (Johnson and Wichern 1998). The outcome of this cluster analysis is several clusters of households, with each cluster displaying a distinct food expenditure pattern.

The BLS aggregates subcategories of food at home into 18 standard categories: cereals, bakery products, beef, pork, other meat, poultry, sea food, eggs, milk products, other dairy products, fresh fruit, fresh vegetables, processed fruits, processed vegetables, sweets, non-alcoholic beverages, oils, and other miscellaneous foods. This standard aggregation is used in this study. For food away from home, the BLS does not have a standard aggregation method. Three categories are created: (1) food away from home at fast food establishments, (2) food away from home at full service establishments, and (3) food away from home at work. While the BLS does not consider alcoholic beverages as food, they are included in this study because alcoholic beverages involve calorie intake and are thus related to obesity. In total, there are 22 food expenditures categories used in this study, including 18 food at home categories, three food away from home categories, and one alcoholic beverages category. Appendix Table A1 gives the details of what foods are included in each category.

Results of the Cluster Analysis

Eight expenditure patterns are identified from the cluster analysis. Because the cluster analysis technique puts more weights on large budget share items, the variances of large budget share categories such as fast food away from home and full service food away from home are better explained than small budget share categories such as eggs and oils. This characteristic is not a severe drawback for analyzing household decision-making in budget allocation since large budget share items figure more prominently in the household decision-making process.

In Table 1, the budget share means are presented for the entire sample, and for each of the eight clusters. The mean budget shares for each cluster indicate that every cluster represented a distinguishable pattern of budget allocation. These clusters are named according to their dominant budget share or shares as: (1) Balanced, (2) Fast-food-dominated, (3) Full-service-dominated, (4) Meat-eater, (5) Miscellaneous-food-dominated, (6) Alcohol-dominated, (7) Beverages-dominated, and (8) Food-at-work-dominated. Demographic profiles for the whole sample and for each cluster are presented in Table 2.

Insert Table 1 and Table 2 about here

Cluster 1. Balanced. About 29.1% of the sample households belong to the Balanced cluster. Compared to households in other clusters, these households allocate more of their food budget to seven out of the 22 categories. These seven categories are cereal, bakery goods, seafood, dairy products other than milk, fresh fruits, processed fruits, and sweets. Households in this cluster also allocate more of their budget to all other food at home categories than the sample average. Table 2 shows that higher than

average proportions of older households, married household, and households living in the urban Northeast belong to this cluster. A much lower than average proportion of single male headed households belongs to this cluster. The average weekly work hour per adult and the average income-to-needs ratio are slightly lower than the sample average. This suggests that members of these households may have more time to prepare meals at home.

Cluster 2. Full-service dominated. About 20.3% of the sample households belong to the Full-service food away from home cluster. On average, households having this expenditure pattern allocate 42.2% of their total food budget to full-service food away from home, much higher than the sample mean at 13.0%. Understandably, households in this cluster spend less than the sample average on all other food categories. However, whatever they spend on food at home is fairly balanced across food categories. Table 2 shows that higher than average proportions of European American households, college-educated households, and households living in Primary Sampling Units (PSUs) that are larger than 4 million people belong to this cluster. This cluster has the highest income-to-needs ratio of all clusters, which means they are economically well off. Their average weekly work hour per adult is slightly higher than the sample average.

Cluster 3. Fast-food dominated. About 18.4% of the sample households belong to the Fast-food-dominated cluster. Households in this cluster spend an average of half of their food budget on fast-food away from home. However, their budget share for full-service food away from home is about half of the sample average. Table 2 shows that higher than average proportions of younger households and single-male headed households belong to this cluster. Also, this cluster of households has the highest average weekly work hours per adult at 33.5 hours, compared to the sample average of 28.9. The

income-to-needs ratio for this cluster is slightly lower than the sample average, indicating less economic well-being.

Cluster 4. Meat-eater. About 11% of the households belong to the Meat-eater cluster. Compared to the sample averages, this cluster of households allocates much more of their food budget to beef (15.4% vs. the sample average of 4.4%), pork (8.9% vs. the sample average of 3.3%), other meats (3.0% vs. the sample average of 2.0%), and poultry (6.9% vs. the sample average of 2.8%). Households in this cluster also allocate more of their budget to eggs, milk products, fresh and frozen vegetables, and oils, compared to the sample average. Table 2 shows that higher than sample average proportions of older households, African American households, Hispanic households, and households living in the urban South belong to this cluster. This group has the lowest income-to-needs ratio, and the second lowest average weekly work hours per adult.

Cluster 5. Miscellaneous-food-dominated. As Appendix Table A.1 shows, miscellaneous foods include soup, frozen food, potato chips and other snacks, nuts, seasonings and condiments, other prepared food, and vitamin supplements. About 9.4% of our sample households belong to this cluster. On average these households allocate 27.0% of their budget to the miscellaneous foods, much higher than the sample average of 9.1%. While they allocate about the sample mean to most of the other food categories, they spend less on all three food away from home items: full service, fast food, and food at work. They also spend less on alcohol. It appears that this group of households substitute store-bought prepared foods (frozen meals, etc.) for food away from home. Table 2 shows that higher than average proportions of younger households, European American households, single-female headed households, households living in the urban

Midwest, and households living in less populated areas belong to this cluster. The average weekly work hours per adult and the income-to-needs ratio are slightly below the sample means.

Cluster 6. Alcohol-dominated. About 7.2% of the households in our sample belong to this cluster. On average about 37.0% of household food budget is spent on alcoholic beverages, compared to the overall sample mean of 5.6%. The budget shares for these households on other food categories are all less than the sample means. Table 2 shows higher proportions of younger households, European American households, college-educated households, single-male headed households, urban households, and households living in medium-sized areas (0.33-1/19 million) belong to this cluster. Households in this cluster have high weekly work hours per adult at 32.1, second only to the fast-food dominated cluster. Their income-to-needs ratio is high with a mean of 4.0, second only to the full-service dominated group.

Cluster 7. Beverage-dominated. About 3.3% of households in our sample belong to this cluster. Households in this cluster allocate 25.6% of their food budget to non-alcoholic beverages, which include carbonated drinks, coffee, tea, fruit-flavored drinks. These households also have the highest cluster average on milk products. On the other hand they allocate much less than average on food away from home categories. Table 2 shows higher proportion of older households, households with high school education or less, single female headed households, rural households, and households living in small areas belong to this cluster. They also have the lowest average weekly work hours per adult, and the second lowest income-to-needs ratio (second only to the Meat-eaters cluster).

Cluster 8. Food-at-work-dominated. This is the smallest cluster for our sample, with only 1.6% of households belonging to this cluster. Households in this cluster allocate more than half of their food budgets (53.4%) to food at work. The allocations of their food budget to all other food categories are typically less than the sample averages. Table 2 shows that higher than average proportions of those less than 25 years old, those between 45-54 years old, those of African American origin and other races, those living in urban Northeast and Midwest, those living in medium size areas (0.33-1.19 million) belong to this cluster. Households in this cluster have higher average weekly work hours per adult, and slightly higher income-to-needs ratio than the overall sample means.

Overall, two food-at-home clusters have been identified: the Balanced cluster and the Meat-eater cluster. The Balanced cluster seems to have a food expenditure pattern that is consistent with nutritional recommendations to eat a variety of foods and to avoid too much of the types of foods that may entail high fat, such as meat. The Meat-eater cluster, on the other hand, may have too much of an emphasis on meat intake and thus fat intake. The other six clusters are clearly dominated by one type of food. Three of the six are food-away-from-home dominated: Full-service, Fast-food, and Food-at-work. In the Miscellaneous-food-dominated cluster, households use a large amount of store-bought prepared food (e.g., frozen meals). The last two are liquid groups, one focusing on alcoholic averages while the other spends a considerable portion of its food budget on non-alcoholic beverages.

Past research suggests that the frequency of eating food away from home, especially fast food consumption, is positively associated with obesity and body fatness (McCrory, Fuss et al. 1999; Bowman and Vinyard 2004; Pereira, Kartashov et al. 2005).

In addition, a higher level of consumption of artificial sweetner, meat and meat products, high-fructose corn syrup, and soda are associated with obesity (Stellman and Garfinkel 1988; Heseker, Hartmann et al. 1995; Bray, Nielsen et al. 2004). As such, membership in the Full-service, Fast-food, Meat-eater, Miscellaneous and Beverage clusters are likely to be positively associated with high BMI, whereas membership in the Balanced cluster is likely to be negatively associated with high BMI. The relationship between BMI and the Alcohol, and Food-at-work clusters are less clear.

Methods and Measurements for Multivariate Analysis

The next step is to investigate the determinants of the identified food expenditure patterns. Neoclassical demand theory suggests that households attempt to maximize their consumption choices subject to preferences and resource constraints. Socio-demographic factors affect a household's preferences for food expenditure choices. Prices, income, and time constraints all affect a household's decision of where to spend its food dollars. Mathematically food demand D is a function of food prices (P), Income (M), time constraint (t), and preferences (PR):

$$D=f(P, M, t, PR) \quad (1)$$

A standard set of preference shifters are used in this study. These variables include: (1) the reference person's socio-demographic characteristics; (2) the household's characteristics, and (3) characteristics of the community in which the household resides. For married households, the reference person is the spouse who is employed. If both spouses or neither spouse are employed, then the spouse with the higher education level is designated as the reference person. The reference person's measured socio-

demographic characteristics include age (less than 25, 25-34, 35-44, 45-54, 55-64, 65 or older), education (less than high school, high school, some college, college or more), and race/ethnicity (European Americans, African Americans, Hispanic Americans, and Others). Household characteristics include family type (married, single female head, single male head, and other families). Community characteristics include region (urban Northeast, urban Midwest, urban South, urban West, rural), and population size of the metropolitan area (greater than 4 million, between 1.2 and 4 million, between 0.33 and 1.19 million, between 125 and 329.9 thousand, and less than 125 thousand).

The CE does not gather price information and thus, we cannot directly measure variation in prices. The location variables presented above also serve as price proxies to capture price differences across different regions and areas. For income, we use income-to-needs ratio which takes into consideration household size. Time constraints are measured by average weekly work hours per adult in the family.

While we use the neoclassical consumer demand model to guide our multivairate analysis, it should be noted that we do not make an attempt to model household decision of food purchase choices in a rigorous manner. Rather, we try to find socio-economic factors that are associated with particular household food expenditure patterns. In that sense the multivariate analysis is exploratory in nature. As such, no explicit hypotheses are formed. However, we do expect that households in which the adults work more hours are more likely to be in the food-away-from-home clusters, especially the fast-food dominated cluster, because the purchase of food away from home reduces food preparation time. We also expect households with higher income-to-needs ratios are more likely to be in the full-service food away from home cluster because full service

restaurants are typically income elastic goods. Because of the traditional gender roles, we also expect, compared to married households and single female headed households, single male headed families to be less likely to be in clusters that require a lot of at-home food preparation, such as the balanced and the meat-eater clusters.

Because cluster membership is a categorical variable, an unordered multinomial logit analysis is used. Following Maddala (1983), the multinomial logit model is specified as:

$$\log(\frac{P_i}{P_m}) = \beta_i' x, \qquad i = 1,2,...m-1, \tag{2}$$

where P_i is the probability that a certain observation falls into the i^{th} cluster, and x the set of preference and constraints variables presented above with β as corresponding regression coefficients. Note the x vector includes *P, M, t,* and *PR*. A total of *(m-1)* binary logit equations are fit simultaneously and the sum of the m predicated probabilities is restricted to be one. The dependent variables of the multinomial logit analysis are the log-odds ratios of being in cluster i versus in cluster m. A household's probability of inclusion in cluster i is computed using

$$P_j = \frac{e^{\beta_j' x}}{1 + \sum_{j=1}^{m-1} e^{\beta_j' x}} \qquad j = 1,2,...m-1, \tag{3}$$

and the household's probability of inclusion in cluster m is calculated using:

$$P_m = \frac{1}{1 + \sum_{j=1}^{m-1} e^{\beta_j' x}}. \tag{4}$$

The household's marginal probability of inclusion in cluster i for variable x_i is computed as:

$$\frac{\partial P_j}{\partial x_i} = \beta_{ji} P_j - P_m P_j \sum_{j=1}^{m-1} \beta_{ji} e^{\beta' j x} \qquad j = 1,2,....,m-1. \tag{5}$$

and the household's marginal probability of inclusion in cluster *m* for variable x_i is:

$$\frac{\partial P_m}{\partial x_i} = -\sum_{j=1}^{m-1} \frac{\partial P_j}{\partial x_i}. \tag{6}$$

Results of the Multivariate Analysis

Table 3 shows the results of our multinomial logit analysis. For ease of interpretation we compute the marginal effects for each observation in the sample. The means of these marginal effects are computed and reported in Table 3. The McFadden pseudo-R^2 of the model is 0.18. Other than the dummy variable indicting PSU size smaller than 125,000, all independent variables are at least jointly statistically significant at 95% confidence level.

Age. The probability of being in the Full-service-dominated cluster increases with age, while the probability of being in the Fast-food-dominated cluster and the Food-at-work cluster decreases with age, *ceteris paribus*. In addition, those who are 34 and younger are more likely to be in the Miscellaneous-food-dominated group and the Alcohol-dominated group, compared to those who are 65 and older. The effect of age is the largest for the Fast-food cluster, with those less than 25 being 24.6% more likely to be in this cluster, compared to those who are 65 or older. There are two explanations for this age trend: one is a life-cycle explanation, in that for life-cycle stage reasons younger households are more likely to eat in fast food establishments. When they get older their tastes may change and they may move to other clusters. The other is a cohort explanation, in that there are fundamental differences in the younger households compared to the older

households so the younger households will prefer fast food consumption compared to the older groups even when they grow older. Given the research evidence that high level of fast food consumption is positively linked to overweight and obesity, the cohort explanation would paint a very bleak forecast of future obesity trends. Further study is needed to empirically decompose these two effects.

Ethnicity. Compared to European Americans, all minority groups are more likely to be in the Meat-eater cluster, with African American households 13.3% more likely and Hispanic households 12.7% more likely, on average, holding other things equal. African Americans and Hispanics are less likely to be in the Full-service, Miscellaneous, and Alcohol clusters compared to European Americans. In addition, African American households are more likely to be in the Fast-food and Food-at-work clusters, compared to European American households. These ethnic differences raise concern for African and Hispanic Americans because high fast food consumption and meat consumption have been linked to high BMI ((Stellman and Garfinkel 1988; Heseker, Hartmann et al. 1995; McCrory, Fuss et al. 1999; Bowman and Vinyard 2004; Bray, Nielsen et al. 2004; Satia, Galanko et al. 2004). It is known in the literature that African Americans and Hispanic Americans have higher BMI levels than White Americans. While this may be attributable to ethnic-specific genetic effects, ethnic-specific food preferences is also a possible explanation.

Education. Households headed by a college-educated person are less likely to be in the Fast-food, Meat-eater, and Beverage clusters, compared to those headed by a high school graduate or less, *ceteris paribus*. On the other hand, households headed by a person with a less-than-high-school education are 7.4% more likely to be in the Meat-

eater cluster and 1.2% more likely to be in the Beverage cluster, compared to households headed by a high-school graduate. This implies that college education matters in choosing what are commonly identified as healthful diets.

Gender and Family Type. Single-headed households are less likely to be in the Balanced cluster compared to married households; and the difference is larger for single-male-headed households compared to single-female-headed households (13.3% less vs. 4.8% less), holding all other factors constant. Single-male-headed households are more likely to be in the Alcohol cluster (13.2% more likely), the Fast-food cluster (3.3% more likely), and the Food-at-work cluster (2.6% more likely). The difference between single-female headed households and married households are smaller. Single-female-headed households are more likely to be in the Beverage cluster (1.3% more likely), Food-at-work (1.0% more likely), and less likely to be in the Meat-eater cluster (1.8% less likely) compared to married-couple households. One explanation of this gender and family composition difference is that women have more food-preparation skills than men, and as such, households with an adult female present are more likely to have more balanced food expenditure patterns.

Location. Households residing in urban Northeast and in rural areas are more likely to be in the Balanced cluster, compared to households residing in urban Midwest, South, and West, *ceteris paribus*. In turn, the urban West, South, and Midwest households are more likely to be in the Fast-food (3.7% to 4.5% more likely) and Miscellaneous-food clusters (1.4% to 3.0% more likely). For urban areas, population size is positively related to membership in the Full-service cluster, probably an indication of both access issues and location-specific life-style differences.

Work hours and income/needs ratio. Households in which the average adult market work hours are more than 35 hours per week are more likely to be in the Full-service and Fast-food clusters (1.1% and 4.6% more likely, respectively), compared to otherwise similar households working less than 35 hours per week per adult, *ceteris paribus*. This is consistent with the notion that consumption of food away from home, especially fast food, is positively correlated with adult market work hours. Similarly, the higher the income-to-needs ratio, the more likely the household belongs to these two clusters, but this income effect is larger for the Full-service cluster than for the Fast-food cluster. A higher income-to-needs ratio is also positively associated with the probability of being in the Alcohol and Food-at-work clusters, but negatively associated with the probability of being in the Meat-eater cluster.

In summary, age, ethnicity, education, gender/family type, and region/population size all affect household food expenditure patterns. If we subscribe to the idea that a Balanced pattern is good for health, then younger, African American and Hispanic American, less-educated, and households headed by single individuals are less likely to have this healthy Balanced food expenditure pattern. In addition, households with higher average adult market work hours and households with higher needs-adjusted incomes are less likely to have the Balanced pattern. Households living in the urban Midwest, South, and West, and in rural areas, and households living in either very large metropolitan areas or in very small areas are less likely to have the Balanced food expenditure pattern as well.

Conclusions and Implications

Energy intake changes start with changing the point of purchase decisions. In this paper, we identify eight constellations of food expenditures that are more and less likely to be associated with healthy eating habits. While the nutrition literature does not agree on what eating patterns are the most healthful, it is generally agreed upon that a balanced, diversified pattern is beneficial to energy balance. Our findings show that only 29 percent of all households in this nationally representative survey fall into the Balanced purchasing cluster that is likely to be the most healthful. In sharp contrast, 40 percent of the households in this survey typically spend between 40 and 50 percent of their food budgets on meals eaten away from home (including those eaten at work). The generally poorer nutritional content and higher caloric content of these meals increase the likelihood that such eating habits are contributing to the growing energy balance problem in the United States.

Educational efforts should focus on teaching people about the nutritional benefits of eating more home prepared meals and strategies for keeping energy intake in balance when eating out (e.g., splitting meals). It is likely that many households may not even realize that by eating out, they are increasing both their caloric intake (e.g., through higher portion sizes) and their intake of fat, while reducing their intake of essential micronutrients and fiber such as vegetables (McCrory, Fuss et al. 1999; Bowman and Vinyard 2004; Satia, Galanko et al. 2004). Education regarding the nutritional implications of eating food away from home may be a good first step towards positive changes in energy intake.

We find that higher work hours and higher needs-adjusted incomes are associated with an increased likelihood of being in one of the food-away-from home groups. These

associations are particularly important given the upward trends in women's labor force participation rates and real median household income over the past 20 years (U.S. Census, Tables 586 and 682). With less available time to prepare meals and more real disposable income, households appear to be choosing to spend more of their food dollars on high calorie meals prepared away from home. While education programs targeted at focused groups (e.g., nutrition/cooking programs targeted at male and female high school students), may have some impact, the trend toward spending a sizable share of the household food budget on meals prepared away from home is likely to continue. With fully 40 percent of the households falling into one of the food away from home clusters, it is imperative that researchers attempt to "unpack" the food away from home expenditures to gain a better understanding of the factors that may be influencing purchase choices within this sizable, and likely growing, segment of the population.

We also find that younger households are much more likely to be in the Fast-food-dominated cluster, and less likely to be in the Balanced cluster. Given the cross-sectional nature of our analysis, we cannot ascertain whether this is a life-cycle effect or a cohort effect. In either cases, but especially in the case of a cohort effect, educational efforts about healthy eating should focus on younger age groups. In addition, we also find that single male-headed households are much less likely to be in the Balanced cluster, and much more likely to be in the Alcohol cluster, compared to married households. Because of gender roles, males are more likely to lack the human capital to prepare nutritious meals at home. Given that the percentage of single male-headed households have been increasing in the U.S. (U.S. Bureau of Census 2006), it is important that cooking and nutrition education reaches this male population. Indeed, this may be an

important argument for making nutrition and cooking classes a requirement for high school students, both male and female, so all high school graduates can be equipped with basic skills of nutrition and healthy eating.

In addition, we find that African Americans and Hispanic Americans are much more likely to have a Meat-eater pattern, compared to European Americans. From the literature we know African Americans and Hispanic Americans are more likely to be overweight (American Obesity Association 2006). While there might be ethnic-specific genetic effects, it is possible that their food preferences may also have an effect. While ethnic-specific genetic effects are difficult to modify, educational efforts may be put forward in African American and Hispanic American communities about decreasing meat consumption while increasing consumption of grains, vegetables, etc. Further research is needed to ascertain if race/ethnicity interacts with other covariates to explain differences in these groups' eating patterns.

It should be noted that household food expenditures are only one aspect of food intake. Although food expenditures and food consumption are likely to be highly correlated, not all food purchased will be consumed, and different individuals in a household may consume very different amounts of certain foods purchased by the household. Nevertheless, the identification of household food expenditure patterns provides useful information in understanding the food intake choices of households.

In summary, based on our findings, we suggest that educational efforts be focused on targeting the young people, the male population, and minorities. Such education efforts should focus on teaching cooking skills, on understanding of the nutritional impact of food away from home on obesity, and on the impact of consumption of meat on

obesity. Further research is needed to "unpack" food away from home expenditures to gain a better understanding of the factors that may be influencing purchase choices within this sizable, and likely growing, segment of the population.

Appendix A.

Table A1.

Food Category	Description
Cereal	(1) flour, (2) prepared flour mixes, (3) cereal, (4) rice, (5) pasta, cornmeal, and other cereal products
Bakery products	(1) white bread, (2) bread other than white, (3) fresh biscuits, rolls, muffins, (4) cakes and cupcakes, fresh and other, excluding frozen; (5) cookies, excluding refrigerated dough, (6) crackers, excluding crumbs, (7) bread and cracker products, (8) doughnuts, sweet rolls, coffeecakes, fresh and other, excluding frozen, (9) frozen refrigerated and canned bakery products, such as biscuits, rolls, muffins, cakes, cupcakes, doughnuts, pies, tarts, turnovers, and miscellaneous products, including dough and batter, (10) pies, tarts, turnovers, fresh and other, excluding frozen
Beef	(1) ground beef, excluding canned, (2) chuck roast, excluding canned, (3) round roast, excluding canned, (4) other beef roast, excluding canned, (5) round steak, excluding canned, (6) sirloin steak, excluding canned, (7) other steak, excluding canned, (8) other beef, excluding canned
Pork	(1) bacon, (2) pork chops, (3) ham, excluding canned, (4) other pork, excluding canned, (5) pork sausage, excluding canned, (6) canned ham
Other meats	(1) frankfurters, excluding canned, (2) bologna, liverwurst, salami, excluding canned, (3) other lunchmeat, (4) lamb and organ meats, excluding canned, (5) mutton, goat, game
Poultry	(1) fresh and frozen whole chicken, (2) fresh or frozen chicken parts, (3) other poultry
Seafood	(1) canned fish, seafood and shellfish, (2) fresh fish and shellfish, (3) frozen fish and shellfish
Eggs	(1)eggs
Milk Products	(1) fresh milk all types, (2) cream
Other dairy	(1) butter, (2) cheese, (3) ice cream and related products, including frozen yogurt, (4) other dairy products, including powdered milk, and fresh, canned and non-frozen yogurt
Fresh fruits	(1) apples, (2) bananas, (3) oranges, (4) other fresh fruits, (5) citrus fruits excluding oranges
Fresh vegetables	(1) potatoes, (2) lettuce, (3) tomatoes, (4) other fresh vegetables
Processed fruits	(1) frozen orange juice, (2) frozen fruits, (3) frozen fruit juices, (4) fresh fruit juices, (5) canned/bottled fruit juices, (6) canned fruits, (7) dried fruits
Processed vegetables	(1) frozen vegetables, (2) canned beans, (3) canned corn, (4) miscellaneous canned vegetables, not collected in a separate UCC, (5) other processed dried vegetables, such as squash, not collected in a separate UCC, (6) dried peas, (7) dried beans, (8)

	dried carrots, onions, leafy greens, and cabbage, (9) frozen vegetable juices, (10) fresh/canned vegetable juices
Sweets	(1) candy and chewing gum, (2) sugar, (3) artificial sweeteners, (4) jams, jellies, preserves and other sweets
Non-alcoholic beverages	(1) cola drinks, (2) other carbonated drinks, (3) coffee, roasted, (4) coffee, instant or freeze dried, (5) noncarbonated fruit flavored drinks, including lemonade-non frozen, (6) tea, (7) other noncarbonated beverages and ice, excluding coffee and tea, (8) nonalcoholic beer
Oils	(1) margarine, (2) fats and oils, (3) salad dressings, (4) non-dairy cream substitutes, (5) peanut butter
Misc. foods	(1) soup, (2) frozen meals, (3) frozen prepared food other than meals, (4) potato chips and other snacks, (5) nuts, (6) salt, other seasonings & spices, (7) olives, pickles, relishes, (8) sauces and gravies, (9) other condiments, (10) prepared salads, (11) prepared desserts, (12) baby food, (13) miscellaneous prepared foods including items such as canned meats not included in previous categories, fresh and canned ethnic foods, fresh and canned pizza, (14) vitamin supplements
Fast food	(1) lunch at fast food, (2) lunch at vending machine, (3) dinner at fast food, (4) dinner at vending machine, (5) snacks at fast food, (6) snacks at vending machine, (7) breakfast at fast food, (8) breakfast at vending machine, (9) catered affair at fast food, (10) catered affair at vending machine, (11) board at fast food, (12) board at vending machine
Full service food	(1) lunch at full service, (2) dinner at full service, (3)snacks at full service, (4) breakfast at full service, (5) catered affair at full service, (6) board at full service
Food at work	(1) lunch at employer, (2) lunch at board, (3) lunch at catered affairs, (4) dinner at employer, (5) dinner at board, (6) dinner at catered affairs, (7) snacks at employer, (8) snacks at board, (9) snacks at catered affairs, (10) breakfast at employer, (11) breakfast at board, (12) breakfast at catered affairs, (13) board at employer, (14) board, (15) board at catered affairs, (16) catered affairs at employer, (17) catered affairs at board, (18) catered affairs
Alcoholic beverages	(1) beer and ale at home, (2) whiskey at home, (3) wine at home, (4) other alcoholic beverages at home, (5) beer at fast food, (6) beer at full service, (7) beer at vending machine, (8) beer at employer, (9) beer at board, (10) beer at catered affairs, (11) wine at fast food, (12) wine at full service, (13) wine at vending machine, (14) wine at employer, (15) wine at board, (16) wine at catered affairs, (17) alcoholic beverage excluding beer/wine fast food, (18) alcoholic beverage excluding beer/wine full service, (19) alcoholic beverage excluding beer/wine vending machine, (20) alcoholic beverage excluding beer/wine at employer, (21) alcoholic beverage excluding beer/wine at Board, (22) alcoholic beverage excluding beer/wine catered affairs

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Table 1. Eight clusters of food expenditure patterns

Food Category	Entire sample	Ba-lanced	Full Service	Fast Food	Meat Eater	Misc Foods	Alcohol	Be-verage	Work
Cereal	3.14	4.46	1.96	2.06	4.44	3.48	1.73	3.51	1.67
Bakery products	6.09	8.94	3.90	4.17	6.04	7.05	3.87	8.62	3.37
Beef	4.42	3.74	2.68	2.53	15.40	3.41	3.00	2.98	1.64
Pork	3.30	3.85	1.78	1.88	8.93	2.38	2.16	3.17	1.58
Other meats	1.99	2.74	1.12	1.29	3.01	2.35	1.22	2.66	0.87
Poultry	2.84	3.57	1.59	1.56	6.92	2.36	1.65	2.72	1.16
Seafood	1.98	3.12	1.27	0.90	3.03	1.65	1.32	1.53	1.16
Eggs	0.79	0.97	0.46	0.55	1.46	0.74	0.50	1.26	0.35
Milk Products	3.16	4.12	1.92	2.49	4.24	3.27	1.97	5.36	1.84
Other dairy	3.88	5.66	2.47	2.41	3.88	5.30	2.95	4.30	1.79
Fresh fruits	3.43	5.39	2.48	2.01	3.91	3.26	1.76	3.34	1.75
Fresh vegetables	3.41	5.04	2.26	1.73	5.20	3.21	2.41	3.28	1.52
Processed fruits	2.36	3.49	1.63	1.59	2.56	2.78	1.38	2.13	1.28
Processed vegetables	1.64	2.31	0.98	0.93	2.42	1.99	1.20	1.84	0.46
Sweets	2.31	3.37	1.48	1.71	1.98	3.01	1.23	3.18	1.42
Non-alcoholic beverages	5.30	5.38	3.26	4.28	4.87	5.52	4.43	25.63	2.88
Oils	1.68	2.38	1.00	0.99	2.42	2.01	0.98	2.28	0.58
Misc. foods	9.06	10.11	5.38	5.74	6.08	26.97	6.06	9.58	3.59
Fast food	18.28	10.68	13.43	49.98	7.83	11.31	12.81	8.29	10.81
Full service food	13.00	6.32	42.20	6.45	2.17	4.42	9.01	2.14	4.67
Food at employment	2.37	1.83	1.40	1.73	0.98	1.32	1.40	0.84	53.35
Alcoholic beverages	5.56	2.56	5.37	3.03	2.25	2.23	36.97	1.35	2.24
Sample size	10967	3192	2231	2017	1181	1030	786	360	170
Proportion		0.29	0.20	0.18	0.11	0.09	0.07	0.03	0.02

Table 2. Sample means by cluster

Variables	Entire sample	Balanced	Full Service	Fast Food	Meat Eater	Misc Foods	Alcohol	Beverage	Work
Age (%)									
<25	8.5	4.6	6.3	15.3	6.1	10.0	13.7	5.5	17.6
25-34	18.8	15.9	17.2	24.6	16.8	22.5	21.1	13.0	15.6
35-44	22.7	24.1	20.4	26.0	20.9	19.7	21.8	23.4	23.6
45-54	19.5	19.6	21.0	17.4	19.9	18.3	19.8	20.8	23.4
55-64	12.2	13.4	14.1	8.0	14.7	10.3	10.3	17.2	7.6
>=65	18.3	22.4	21.0	8.7	21.6	19.3	13.2	20.1	12.2
Ethnicity (%)									
European American	74.3	74.2	83.9	69.9	54.8	79.9	82.8	76.6	62.2
African American	11.9	11.2	5.6	15.1	23.2	9.3	8.0	11.1	22.8
Hispanic	9.8	10.0	6.2	10.9	17.7	8.3	6.6	8.8	9.3
Other Race	4.1	4.6	4.2	4.2	4.3	2.6	2.6	3.4	5.7
Education (%)									
< High school	14.6	15.6	7.2	13.5	29.2	15.1	10.0	22.6	7.5
High school	58.0	57.0	53.2	63.0	57.1	58.3	58.6	64.0	66.3
College or more	27.4	27.5	39.6	23.5	13.7	26.6	31.4	13.5	26.2
Gender/family type (%)									
Married	51.2	57.6	55.9	45.0	52.2	48.0	37.9	43.5	35.2
Single female headed	29.5	30.9	22.9	30.2	35.4	33.0	22.9	37.8	30.3
Single male headed	19.3	11.4	21.2	24.8	12.4	19.0	39.2	18.7	34.5
Other nonfamilies	13.5	12.4	11.2	15.8	16.7	12.3	15.9	14.6	6.3
Region (%)									
Urban Northeast	16.6	19.2	18.2	12.6	15.0	12.9	18.7	14.1	22.0
Urban Midwest	19.4	18.1	19.7	21.0	13.6	22.6	22.6	16.4	30.9
Urban South	30.8	28.2	31.8	33.4	37.4	29.9	27.6	23.9	27.4
Urban West	20.1	19.7	19.3	21.2	18.0	21.8	21.9	22.7	13.4
Rural	13.2	14.8	10.9	11.8	16.0	12.8	9.3	22.9	6.3
PSU size(%)									
>4 million	24.4	25.5	29.2	22.2	22.5	18.0	23.4	22.6	24.1
1.2-4 million	21.2	19.4	21.9	21.4	20.5	24.0	24.8	18.1	20.2
0.33-1.19 million	17.3	17.3	16.3	18.1	19.4	16.1	18.2	11.1	25.1
125 -329.1 thousand	11.9	12.1	10.4	11.9	10.2	16.4	11.9	13.8	8.7
< 125 thousand	25.2	25.7	22.1	26.3	27.3	25.5	21.7	34.4	21.9
Avg. weekly work hour per adult > 34 (%)	53.5	46.8	56.6	64.3	43.9	50.2	61.8	46.7	63.2
Income-to-needs ratio	3.6	3.2	5.2	3.4	2.5	3.2	4.0	2.7	3.7
Sample size	10967	3192	2231	2017	1181	1030	786	360	170
Proportion	100%	29.1%	20.3%	18.4%	10.8%	9.4%	7.2%	3.3%	1.6%

Table 3. Average marginal probability of cluster inclusion

Variables	Balanced	Full Service	Fast Food	Meat Eater	Misc Foods	Alcohol	Beverage	Work
Age (>=65)								
<25	-14.3%	-10.3%	24.6%***	-5.3%	0.3%***	3.9%***	-1.3%	2.4%***
25-34	-9.1%	-10.6%*	17.6%***	-2.6%	3.0%***	1.8%***	-0.1%	0.1%
35-44	-4.0%	-10.9%***	13.5%***	-1.1%	0.0%	0.7%	1.1%**	0.6%
45-54	-3.1%	-9.5%***	6.7%***	0.8%	1.1%	1.7%**	1.4%**	0.9%*
55-64	-1.8%	-6.2%**	3.1%**	2.3%**	-0.1%	0.6%	2.3%***	-0.1%
Ethnicity (Euro. American)								
African American	-3.2%	-7.5%***	2.3%**	13.3%***	-3.5%***	-2.8%***	-0.9%	2.2%***
Hispanic	-1.5%	-4.3%***	-0.8%	12.7%***	-3.0%**	-2.2%***	-1.4%*	0.4%
Other Races	2.8%	-2.6%*	0.6%	4.0%*	-2.7%***	-2.9%***	-0.6%	1.5%*
Education (High school)								
< High school	-1.9%	-5.4%***	0.4%	7.4%***	-0.2%	-0.9%	1.2%*	-0.5%**
College or more	2.2%	4.5%	-3.4%***	-2.4%***	0.1%	0.2%	-1.1%***	-0.3%
Gender/family type (married)								
Single female headed	-4.8%	-1.5%	3.3%	-1.8%***	2.0%	0.6%***	1.3%**	1.0%***
Single male headed	-13.3%	-0.3%***	3.3%***	-4.6%	-1.0%***	13.2%***	0.2%***	2.6%***
Other nonfamilies	3.8%	-1.2%**	-1.1%**	2.9%	-1.9%***	-1.2%***	-0.2%	-1.0%***
Region (Urban Northeeast)								
Urban Midwest	-4.6%	-0.9%	4.5%***	-1.7%	3.0%***	-0.4%	-0.1%	0.0%
Urban South	-5.8%	2.5%***	3.7%***	0.5%**	1.4%***	-1.5%	0.0%	-0.8%
Urban West	-3.4%	-2.1%	3.9%***	-1.0%	2.7%***	-0.4%	1.0%**	-0.7%*
Rural	-1.3%	-2.8%	0.5%	2.9%	0.8%	-1.6%	2.3%*	-0.8%**
PSU size (>4 million)								
1.2-4 million	-2.4%	-2.9%	-0.3%	0.8%	3.5%***	1.5%**	-0.4%	0.0%
0.33-1.19 million	-0.2%	-4.8%***	1.7%	1.6%	0.7%	0.8%	-1.1%**	1.3%***
125 -329.1 thousand	0.4%	-4.5%***	-0.3%	-0.4%	4.6%***	0.6%	-0.1%	-0.2%
< 125 thousand	-2.7%	-2.0%	2.0%*	-0.5%	2.2%**	0.2%	0.1%	0.6%*
Avg. work hour / adult > 34	-3.5%	1.1%**	4.6%***	-0.8%	-1.3%	0.0%	-0.4%	0.1%
Income-to-needs ratio	-1.0%	1.6%***	0.1%***	-0.8%***	-0.1%	0.4%***	-0.1%	0.1%***